

water for their survival. In the Stanislaus, Tuolumne, and Merced rivers, salmon and steelhead are confined to the floodplains of the rivers below large, impassable dams. Maintaining cool water below the dams is essential to maintaining salmon and steelhead in these rivers. Summer and early fall water temperatures in floodplains of these rivers are naturally warm, but are kept cool, at least in the upper reaches below the dams, by coldwater releases from deeper bottom waters of the major reservoirs. The extent of cool water habitat below the dams depends on the amount of cold water released from the dams, the extent of shade provided by riparian (waterside) vegetation, the extent that dredger ponds are connected to the rivers, the amount of water diverted from the river channel, and the amount of warm water discharge into the rivers from urban and agricultural drainage. Improving water temperatures in the three rivers below the major reservoirs in this zone can contribute to the overall ecological health of the system and promote sustainable fisheries. Steelhead particularly depend on cool summer water temperatures, because their young remain in the rivers through summer before migrating to the ocean. High fall water temperatures in the lower rivers hinder upstream migrations of adult fall-run chinook salmon and steelhead. The vision for water temperatures in these rivers is to provide sufficient summer and early-fall base flows in the river channels and restore the riparian corridors and natural stream channel characteristics that limit heating of the rivers. Storing sufficient coolwater in the reservoirs during drought will also help to maintain a minimum of coolwater habitat in the rivers.

VISIONS FOR HABITATS

RIPARIAN AND RIVERINE AQUATIC HABITATS: Riparian and shaded riverine aquatic (SRA) habitats are important to the health of the rivers. They provide shade, insects and organic debris that are important to the aquatic foodweb, and soil and bank protection. The riparian corridors and related SRA habitat are impaired by lack of a natural functioning stream meander process, confinement of the river channels by bank protection and levees, and loss of streamside vegetation to animal grazing, levee construction, removal of large woody debris from stream channels and banks, and agricultural clearing. The vision is to improve and restore riparian and SRA habitat along the three rivers, where possible and as

needed. Included in this vision is the consideration of other riparian communities such as Great Valley valley oak, Great Valley mixed riparian, cottonwood-willow-sycamore, and elderberry savanna.

FRESHWATER FISH HABITAT: Freshwater fish habitat is an important component needed to ensure the sustainability of resident native and anadromous fish species. The Stanislaus, Tuolumne, and Merced rivers are typical of fall chinook salmon spawning streams (Moyle and Ellison 1991). The quality of freshwater fish habitat in these rivers should be maintained through actions directed at streamflows, coarse sediment supply, stream meander, natural floodplain and flood processes, and maintaining and restoring riparian and riverine aquatic habitats.

ESSENTIAL FISH HABITAT: The Stanislaus, Tuolumne, and Merced rivers have been identified as Essential Fish Habitat (EFH) based on the definition of waters currently or historically accessible to salmon (National Marine Fisheries Service 1998). Key features of EFH to maintain or restore in these rivers include substrate composition; water quality; water quantity, depth and velocity; channel gradient and stability; food; cover and habitat complexity; space; access and passage; and flood plain and habitat connectivity.

VISIONS FOR REDUCING OR ELIMINATING STRESSORS

WATER DIVERSIONS: Water diversions along the rivers divert not only water, but small fish. Many diversions are screened to reduce young fish loss. Reducing losses to screened and unscreened diversions will contribute to overall ecosystem health by promoting sustainable fisheries and higher population levels. The vision is to screen those diversions that have no screens or inadequate screens where there is a potential to screen young fish in significant numbers.

DAMS AND OTHER STRUCTURES: Upstream fall-run chinook salmon passage is often limited by the presence of seasonally constructed diversion dams. The vision is to provide alternative diversion methods and to coordinate the annual removal of these dams to improve fish passage. Some adult chinook salmon tend to stray from their natal streams by remaining in the mainstem San Joaquin River and attempting to migrate above the Merced River mouth into

agricultural return water. The vision is that chinook salmon spawning populations in the East San Joaquin Basin Ecological Management Zone will be increased by a seasonal weir that prevents fish from migrating above the mouth of the Merced River.

PREDATION AND COMPETITION: Predation on juvenile chinook salmon by warmwater fish, such as largemouth and smallmouth bass, in the lower reaches of streams in the East San Joaquin Basin Ecological Management Zone is a significant source of mortality. The vision is that predation will be reduced by a combination of actions to control predator populations and isolate predator habitat. These actions will contribute to improved survival of native San Joaquin Basin chinook salmon. —

HARVEST OF FISH AND WILDLIFE: The legal and illegal anadromous fish harvest in the river, estuary, and ocean limits recovery of wild fall-run chinook salmon populations in the three rivers. Reducing the harvest may be necessary to allow recovery of wild populations. The vision is to continue to reduce the harvest of wild anadromous fish and focus legal harvest on hatchery stocks of salmon and steelhead.

ARTIFICIAL PROPAGATION OF FISH: Stocking hatchery-reared salmon in the Merced River supports important sport and commercial fisheries and helps to compensate for the loss of salmon and steelhead caused by the construction of large dams and reservoirs. Hatchery fish also supplement the numbers of naturally spawning salmon and steelhead in the river. Hatchery supplementation helps sustain fishable populations through periods of poor wild fish production (e.g., droughts). However, hatchery salmon and steelhead may impede the recovery of wild populations by competing with and preying on young of wild fish and reducing the genetic integrity of the wild populations by breeding with wild fish. The vision is to improving hatchery adult fish selection, spawning, rearing, and release practices to minimize potential conflicts with the naturally-spawning salmon and steelhead populations.

SPECIES VISIONS

CHINOOK SALMON: The vision for chinook salmon is to recover all stocks presently listed or proposed for listing under ESA or CESA, achieve naturally spawning population levels that support

and maintain ocean commercial and ocean and inland recreational fisheries, and that use fully existing and restored habitats. Fall-run chinook salmon will benefit from improved flows. Enhanced spring flow events will improve transport conditions for downstream migrating fall-run chinook. Fall and winter base-flow improvements will benefit upstream migrating fall-run chinook salmon and survival of eggs and fry. Improvements in wetland, riparian, and SRA habitats; stream channel and meander; and gravel recruitment will also improve spawning and rearing habitat. Screening unscreened and poorly screened diversions will improve young salmon production. Limiting harvest will provide adequate numbers of spawners and help sustain long-term fishery harvest.

STEELHEAD: The vision for steelhead trout is to recover this species listed as threatened under the ESA and achieve naturally spawning populations of sufficient size to support inland recreational fishing and that use fully existing and restored habitat. Steelhead will benefit from improved spring flow events in dry and normal years. Spring flows will provide attraction for upstream migrating adults and support downstream migrating juveniles. Improved summer, fall, and winter base flows will maintain fall and winter upstream migrants and over-summering physical habitat and lower water temperatures. Steelhead will also benefit from improved gravel spawning habitat and stream rearing habitat, especially if summer heating of the river is reduced in the process. Screening unscreened and poorly screened diversions will improve young steelhead production.

GIANT GARTER SNAKE: The vision for the giant garter snake is to contribute to the recovery of this State and federally listed threatened species in order to contribute to the overall species richness and diversity. Achieving this vision will reduce the conflict between protection for this species and other beneficial uses of land and water in the Bay-Delta. Protecting existing and restoring additional suitable wetland and upland habitats will be critical to achieving recovery of the giant garter snake. The proposed restoration of aquatic, wetland, and riparian habitats in the East San Joaquin Ecological Management Zone will help in the recovery of these species by increasing habitat quality and area.

WESTERN POND TURTLE: The vision for the western pond turtle is to maintain and restore their abundance and distribution by maintaining or expanding existing populations by improving stream channel, floodplain riparian processes, and reducing predator species.

SWAINSON'S HAWK: The vision for Swainson's hawk is to contribute to the recovery of this State-listed threatened species. Improvements in riparian and agricultural wildlife habitats will aid in the recovery of the Swainson's hawk. Increased abundance and possibly some nesting would be expected as a result of improved habitat.

GREATER SANDHILL CRANE: The vision for the greater sandhill crane is to contribute to the recovery of this California species of special concern. Improvements in pasture lands and seasonally flooded agricultural habitats, such as flooded corn fields, should help toward recovery of the greater sandhill crane population. The population should remain stable or increase with improvements in habitat.

WESTERN YELLOW-BILLED CUCKOO: The vision for the western yellow-billed cuckoo is to contribute to the recovery of this State-listed endangered species. The yellow-billed cuckoo along the San Joaquin River and its tributaries is not a species for which specific restoration projects are proposed. Potential habitat for the cuckoo will be expanded by improvements in riparian habitat areas. These improvements will result from efforts to protect, maintain, and restore riparian and riverine aquatic habitats throughout the San Joaquin River and East San Joaquin Ecological Management Zones, thus sustaining the river meander belt, and increasing the natural sediment supply to support meander and riparian regeneration.

RIPARIAN BRUSH RABBIT: The vision for the riparian brush rabbit is to assist in the recovery of this State-listed endangered species in the Bay-Delta through improvements in riparian habitat and reintroduction to its former habitat. Restoring suitable mature riparian forest, protecting and expanding the existing population, and establishing new populations will be critical to the recovery of the riparian brush rabbit. Restoration of riparian habitats in the East San Joaquin Basin Ecological Management Zone and adjacent upland plant

communities will help the recovery of this species by increasing habitat area and providing refuge from flooding.

SAN JOAQUIN WOODRAT: The vision for the San Joaquin Valley woodrat is to contribute to the recovery of this federally proposed endangered species through improvement in its habitat.

SHOREBIRDS AND WADING BIRDS: The vision for shorebirds and wading birds is to maintain and restore healthy populations through habitat protection and restoration. Shorebirds and wading birds will benefit from restoration of wetland, riparian, aquatic, and agricultural habitats. The extent of seasonal use of the East San Joaquin Ecological Management Zone by these birds should increase.

WATERFOWL: The vision for waterfowl is to maintain and restore healthy populations at levels that can support consumptive (e.g., hunting) and nonconsumptive (e.g., birdwatching) uses. Many species of resident and migratory waterfowl will benefit from improved aquatic, wetland, riparian, and agricultural habitats. Increase use of the East San Joaquin Ecological Management Zone and possibly increases in some populations would be expected.

NEOTROPICAL MIGRATORY BIRDS: The vision for the neotropical migratory bird guild is to restore and maintain healthy populations of neotropical migratory birds through restoring habitats on which they depend. Protecting existing and restoring additional suitable wetland, riparian, and grassland habitats will be critical to maintaining healthy neotropical migrant bird populations in the Bay-Delta.

NATIVE RESIDENT FISHES: The vision for native resident fish species is to maintain and restore the distribution and abundance.

LAMPREY: The vision for anadromous lampreys is to maintain and restore population distribution and abundance to higher levels than at present. The vision is also to understand life history better and identify factors which influence abundance. Better knowledge of these species and restoration would ensure their long-term population sustainability.

PLANT SPECIES AND COMMUNITIES: The vision for plant species and communities is to protect

and restore these resources in conjunction with efforts to protect and restore wetland and riparian and riverine aquatic habitats.

INTEGRATION WITH OTHER RESTORATION PROGRAMS

Maintaining and restoring the health of the Ecological Management Units in the East San Joaquin Basin Ecological Management Zone will depend on the efforts of local and State water management agencies. Efforts in the basin will be linked to activities of the California Waterfowl Association, Ducks Unlimited, and The Nature Conservancy. Overall, these efforts will require cooperation from resource agencies such as DFG, DWR, USFWS, and the National Marine Fisheries Service (NMFS), as well as participation and support from Reclamation, the U.S. Natural Resources Conservation Service, and other private organizations, water districts, and landowners. These groups will work together to maintain and restore streamflows and fish and wildlife habitat, reduce impacts of diversions, minimize poaching, and minimize habitat and water quality degradation in basin streams. In support of this effort, funding may be provided to enhance streamflows, reduce fish-passage problems, screen diversions, restore habitats, and increase enforcement of the California Fish and Game Code to protect recovering populations of salmon and steelhead. Oakdale and South San Joaquin Irrigation Districts also are active participants in ecosystem restoration efforts on the lower Stanislaus River. The Modesto and Turlock Irrigation Districts play important roles in restoration efforts on the lower Tuolumne River. The districts are working in cooperation with resource agencies on research and restoration projects for fall-run chinook salmon in the basin.

CENTRAL VALLEY PROJECT IMPROVEMENT ACT

Restoring and maintaining ecological processes and functions in the East San Joaquin Basin Ecological Management Zone will augment other important ongoing and future restoration efforts for the zone. This program will complement efforts of the USFWS's AFRP (USFWS 1995). The goal of the program is to double the natural anadromous fish production in the system over the average production

during 1967 to 1991. CVPIA authorized the dedication and management of 800,000 af of CVP yield annually to implement fish, wildlife, and habitat restoration purposes and measures. Because the Stanislaus River is a CVP-controlled stream, a portion of this allocation has been released to the lower river to improve salmon rearing and emigration (the needs of steelhead were not included in this allocation). CVPIA also directed the Secretary of the Interior to evaluate and determine the existing and anticipated future basin needs in the Stanislaus River basin while preparing the Stanislaus River Basin and Calaveras River Water Use Program Environmental Impact Statement.

SALMON, STEELHEAD TROUT AND ANADROMOUS FISHERIES PROGRAM ACT

The vision will also help the DFG reach its goal of doubling the number of anadromous fish that were produced in 1988.

AGREEMENT ON SAN JOAQUIN RIVER PROTECTION

In an effort to resolve issues brought forth in the State Water Resources Control Board's 1995 Water Quality Control Plan for the Bay/Delta, the San Joaquin River Tributaries Association, San Joaquin River Exchange Contractors Water Authority, Friant Water Users Authority, and the San Francisco Public Utilities Commission collaborated to identify feasible, voluntary actions to protect the San Joaquin River's fish resources. In spring 1996, these parties agreed on a "Letter of Intent to Resolve San Joaquin River Issues." This agreement, when finalized, has the potential of providing the following:

- higher minimum base flows,
- significantly increased pulse flows,
- installation and operation of a new fish barrier on the mainstem San Joaquin River,
- set up a new biological monitoring program, and
- set aside federal restoration funds to cover costs associated with these measures.

One of the important components of the Agreement is the development of the Vernalis Adaptive Management Program (VAMP) to improve

environmental conditions on the San Joaquin River. Elements of this potential adaptive management program include a range of flow and non-flow habitat improvement actions throughout the watershed, and an experimental program designed to collect data needed to develop scientifically sound fishery management options for the future.

The future of the Agreement is unknown at this time. However, several actions by the San Joaquin River Stakeholders Policy Group and other parties have been or are presently being implemented throughout the watershed. These actions include:

- Extensive scientific studies of the chinook salmon fishery and habitats on the Tuolumne, Merced, and Stanislaus Rivers;
- Districts have assisted in the bypassing of high river flows around spawning areas as requested by State and federal agencies to provide more stable flows during the fall spawning period;
- Improved instream flows in order to increase naturally occurring chinook salmon populations;
- Water transfers to the USBR pursuant to the CVPIA to help implement a portion of the Anadromous Fish Restoration Program;
- Chinook salmon habitat restoration work;
- Spawning gravel rehabilitation;
- Inventory and development of habitat restoration project proposals;
- Feasibility studies of establishment of a salmon hatchery and rearing facilities.

SAN JOAQUIN RIVER MANAGEMENT PROGRAM (SJRMP)

This program will complement the SJRMP, which was established through State legislation (Chapter 1068/90) to develop comprehensive and compatible solutions to water supply, water quality, flood control, fisheries, wildlife habitat, and recreational needs in the San Joaquin River basin. The program resulted in a final report with recommendations to the California Legislature in February 1995 and has now entered the implementation phase.

FERC LICENCE PROGRAM

Minimum flow requirements below each of the dams on the rivers are required by FERC hydropower licenses. Existing minimum flows in the lower Merced River are designated in FERC License No. 2179 for the New Exchequer Project, issued in April 1964, and the Davis-Grunsky Contract No. D-GGR17 (DWR Contract No. 160282) between DWR and MID, executed in October 1967. The Davis-Grunsky contract requires MID to maintain a continuous flow of between 180 cfs and 220 cfs in the lower Merced River from November 1 through April 1 throughout the reach from Crocker-Huffman Dam to Shaffer Bridge. An agreement was executed in 1995 for the Tuolumne River between 10 stakeholder and resource agencies. It amended the license for the New Don Pedro Project to increase instream flow releases from New Don Pedro Dam. Flows in this agreement were incorporated into a FERC Order Amending License for the New Don Pedro Project.

CALFED BAY-DELTA PROGRAM

CALFED has funded 13 ecosystem restoration projects in the East San Joaquin Ecological Management Zone. Many of the projects restore portions of the Tuolumne and Merced rivers that have been damaged by gravel extraction operations. Another project places gravel in the Tuolumne River to replace gravel captured by upstream reservoirs.

LINKAGE TO OTHER ECOLOGICAL MANAGEMENT ZONES

Many of the resource elements in the East San Joaquin Basin Ecological Management Zone depend extensively on conditions or elements in other zones. Anadromous fish, for example, are highly migratory and depend on conditions in the mainstem San Joaquin River, the Delta, San Francisco Bay, and the nearshore Pacific Ocean. Because these fish are affected by stressors throughout their range, such as unscreened diversions, toxic contaminants, water quality, and harvest, restoring populations in the East San Joaquin Basin Ecological Management Zone will require corresponding efforts in other zones.

The ecosystem health of the East San Joaquin Basin Ecological Management Zone is highly dependent on conditions in the San Joaquin River and Sacramento-

San Joaquin Delta Ecological Management Zones. Stressors there (water diversions and water quality) have a significant effect on resources in this zone. Conditions in San Francisco Bay and the Pacific Ocean can also have a significant effect on resources in this zone.

Stressors in the mainstem San Joaquin River have significant effects on resources in its tributary streams. In particular, reduced streamflow and the high input of contaminants into the mainstem San Joaquin River reduces survival of anadromous fish migrating up and down the river, to and from spawning and rearing areas in the tributary streams.

Water, sediment, nutrient supply, and input of contaminants from the tributary streams in this zone all influence habitat conditions in the mainstem San Joaquin River. Changes in these factors from historical conditions have contributed to habitat degradation on the mainstem river. Maintaining a healthy riparian zone and balanced sediment budget in the mainstem San Joaquin River will depend on appropriate nutrient, water, and sediment input from the major tributaries. Water supply from the tributaries is critical to maintaining aquatic habitat in the mainstem river between the Merced River confluence and Vernalis, because Friant Dam diverts nearly all of the flow from the upper San Joaquin River watershed.

The Sacramento-San Joaquin Delta Ecological Management Zone provides essential habitat for upstream migration of adult anadromous fish and downstream migration and rearing of juvenile anadromous fish from the San Joaquin River basin. Conditions in the Bay-Delta significantly affect anadromous fish production in the San Joaquin River basin, because, in most years, much of the inflow from the basin is diverted in the Delta, and the loss of juvenile salmon and steelhead in Delta water diversions is high. In turn, the magnitude of inflow and the input of nutrients, contaminants, and sediments from the San Joaquin River and its tributaries significantly affect the health of the Bay and Delta ecosystem. Restoring and maintaining a healthy ecosystem in this zone will be critical to restoring the ecosystem in the Bay and Delta.

Additionally, stressors affecting fish and wildlife species using the San Joaquin River basin during at least part of their life cycle occur outside the

identified Ecological Management Zones. For example, ocean recreational and commercial fisheries have a significant effect on the numbers of anadromous fish returning to spawn and rear in the San Joaquin River basin. New harvest management strategies for the ocean fisheries may be needed to ensure restoration of San Joaquin tributary salmon runs.

RESTORATION TARGETS AND PROGRAMMATIC ACTIONS

ECOLOGICAL PROCESSES

CENTRAL VALLEY STREAMFLOWS

TARGET 1: Maintain the following base flows in the Stanislaus River below Goodwin Dam (◆◆):

- in critical, dry, and below-normal years, minimum flows should be 200 to 300 cfs, except for a flow event of 1,500 cfs for 30 days in April and May,
- in above-normal years, minimum flows should be 300 to 350 cfs, except for 800 cfs in June and 1,500 cfs in April and May, and
- in wet years, minimum flows should be 300 to 400 cfs, except for 1,500 cfs from April through June.

PROGRAMMATIC ACTION 1A: Develop a cooperative approach to coordinate flow releases to attain target levels.

TARGET 2: Provide the following 10-day spring flow events on the Stanislaus River: 2,500 to 3,000 cfs in late April or early May in normal years and 3,000 to 4,000 cfs in wet years. Such flows would be provided only when inflows to New Melones Reservoir are at these levels (◆◆).

PROGRAMMATIC ACTION 2A: Develop a cooperative approach to coordinate flow releases to attain target levels.

TARGET 3: Maintain the following base flows in the Tuolumne River below Don Pedro Dam (◆◆):

- in critical and below years, flow release should be 50 cfs from June through September, 100 cfs from October 1-15, 150 cfs from October 16-May 31, plus an 11,091 acre-foot outmigration pulse flow,

- in median critical dry years, flow release should be 50 cfs from June through September, 100 cfs from October 1-15, 150 cfs from October 16-May 31, plus a 20,091 acre-foot outmigration pulse flow,
- in intermediate critical dry years, flow release should be 50 cfs from June through September, 150 cfs from October 1-15, 150 cfs from October 16- May 31, plus a 32,619 acre-foot outmigration pulse flow,
- in median dry years, flow release should be 75 cfs from June through September, 150 cfs from October 1-15, 150 cfs from October 16- May 31, plus a 37,060 acre-foot outmigration pulse flow,
- in intermediate dry-below normal years, flow release should be 75 cfs from June through September, 180 cfs from October 1-15, 180 cfs from October 16- May 31, plus a 35,920 acre-foot outmigration pulse flow and a 1,676 acre-foot attraction pulse flow,
- in median below normal years, flow release should be 75 cfs from June through September, 200 cfs from October 1-15, 175 cfs from October 16- May 31, plus a 60,027 acre-foot outmigration pulse flow and a 1,736 acre-foot attraction pulse flow,
- in all other year types (intermediate below normal/above normal, median above normal, intermediate above normal-wet, and median wet/maximum years), flow release should be 250 cfs from June through September, 300 cfs from October 1-15, 300 cfs from October 16- May 31, plus a 89,882 acre-foot outmigration pulse flow and a 5,950 acre-foot attraction pulse flow.

PROGRAMMATIC ACTION 3A: Develop a cooperative approach to coordinate flow releases to attain target levels.

TARGET 4: Maintain the following base flows in the Merced River below Lake McClure (◆◆):

- in dry years, minimum instream flows at Shaffer Bridge should be 15 cfs from June through October 15, 60 cfs from October 16 through October 31 and January through May, and 75 cfs in November and December, and

- in normal years, minimum instream flows at Shaffer Bridge should be 25 cfs from June through October 15, 75 cfs from October 16 through October 31 and January through May, and 100 cfs in November and December.

PROGRAMMATIC ACTION 4A: Develop a cooperative approach to coordinate flow releases to attain target levels.

TARGET 5: Provide the following 10-day spring flow events on the Merced River: 1,000 to 1,500 cfs in late April or early May in dry years, 2,000 to 2,500 cfs in normal years, and 3,000 to 4,000 cfs in wet years. Such flows would be provided only when inflows to Lake McClure are at these levels (◆◆).

PROGRAMMATIC ACTION 5A: Develop a cooperative approach to coordinate flow releases to attain target levels.

RATIONALE: The proposed supplemental flows were selected as a representative value for impact analysis in the Programmatic EIS/EIR. Throughout the ERP, the need to determine optimal streamflow for ecological processes, habitats, and species is repeated. The issues of supplemental flows are complex in term of ecosystem improvements. The frequency, magnitude, duration, timing and rate of change of streamflows that form channels, create and maintain riparian habitat (including all species of vegetation), and promote all life stages of the various aquatic species dependent on a particular stream will never occur within a single year. An optimal flow regime will have to vary, perhaps significantly, from year to year. The supplemental flow recommendations will be an intensive exercise in adaptive management and must be based on credible scientific underpinnings.

Flows in the Stanislaus, Tuolumne, and Merced Rivers are controlled by releases from foothill storage reservoirs (New Melones, New Don Pedro, and New Exchequer Reservoirs, respectively). Improving base flows would increase habitat for spawning, rearing, and migration of salmon and steelhead. Pulse flows in spring would help to restore natural stream channel processes; gravel recruitment, cleansing, and transport; and riparian vegetation development and survival. These flows also would help to support juvenile salmon and steelhead emigration to the Delta.

In all cases, flows will continually subject to the developing aspects of adaptive management in which decisions are based on the development and evaluation of testable hypotheses. Flow recommendations are linked to water quantity and quality and in the long-term should be designed to contribute to species maintenance and restoration, improving natural or semi-natural ecological functions, and assist in promoting the sustainability of specific types of habitat important to fish, wildlife and plant communities.

Given the wide variety of past and recent flow recommendations, it is apparent that much additional information is required to use existing water supplies to meet all the beneficial uses better, with particular focus on the ecosystem requirements. The basis for ERP flow recommendations eventually will differ significantly from flow recommendations based on the needs of chinook salmon migration, spawning, and rearing. Salmon flows will likely continue to form the core of flow needs, but from the ecosystem perspective, flows will need to meet the need of sediment transport and other channel maintenance processes as well as contribute to sustaining a diversity of aquatic, floodplain and other closely linked habitats such as seasonal wetlands and riparian forests. Still, the present recommendations for "ecosystem" flows suffer from insufficient data regarding better estimates of sediment transport and channel maintenance flows. These are very important aspects of integrating flow prescriptions with actual ecosystem restoration requirements and will require the development of testable hypotheses and the monitoring and research programs necessary to collect and evaluate data to support or refute the hypotheses.

The recommended flow event on the Stanislaus River may be constrained in the short-term by flood control concerns below Goodwin Dam. Full implementation of the proposed flows may depend on land use changes in the floodplain that could be inundated by the flow events. The flow event is closely related to recommendations in this section regarding stream meander corridor and natural floodplains and flood processes.

Minimum flows are necessary in the salmon and steelhead spawning and rearing areas of each of the three rivers to sustain adequate physical habitat, water temperatures, and food supply for juvenile

salmon and steelhead, both of which may be year-round residents. In some cases, base flows may be higher than unimpaired flow. Such flows are necessary, because spawning and rearing habitats for juvenile salmon and steelhead, traditionally located upstream of the dams, now are located downstream.

Flow events are recommended during spring to more closely emulate the natural spring peak-flow pattern. Such flows stimulate and support downstream juvenile salmon and steelhead migration. The spring flow will also mobilize, clean, and transport spawning gravels; create point bars and other instream habitat types; and contribute to a natural channel meandering pattern and riparian scrub and woodland habitat development and maintenance.

DFG (1993) believes existing flow requirements are inadequate for fall-run chinook salmon migration, spawning, egg incubation, juvenile rearing, and smolt emigration on the Merced River. Adequate releases for upstream attraction of adults and spawning begin on November 1, but migration typically begins in October. The current spawning and rearing flow requirements are not the result of scientific studies and may be too low to meet spawning and rearing needs. Flows in the spawning reach during the spawning and early rearing period are further depleted by water diversions. Spring flows for smolt emigration are particularly inadequate.

Flow targets recommended by DFG (1993) for the lower Merced River were derived from instream flow study and smolt survival data from similar drainages. Recommended flows during the spring emigration period are consistent with proposed spring outflow objectives for the basin at Vernalis on the San Joaquin River. Although the proposed flows are a significant improvement over the current flow releases, they are not the most favorable for salmon spawning, rearing, or emigration, particularly in drier years (California Department of Fish and Game 1993).

Flow targets recommended by USFWS (1995) for the Merced River were developed by the AFRP San Joaquin Basin Technical Team. Recommended flows were derived from historical flows and results of biological studies. The team believes that implementing the flow schedule, along with other recommended actions, would double natural fall-run chinook salmon production in the Merced River.

For the lower Tuolumne River, an agreement was executed in 1995 between 10 stakeholder and resource agencies. It amended the license for the New Don Pedro Project to increase instream flow releases from New Don Pedro Dam. Flows in this agreement were incorporated into a FERC Order Amending License for the New Don Pedro Project (July 1996). This new flow agreement is based on ten different water year types. These new flows should be viewed as the experimental baseline for restoring chinook salmon and for their contribution in promoting a healthy alluvial river system.

Flow targets were recommended by DFG (1993) for the lower Tuolumne River following results of an instream flow study (U.S. Fish and Wildlife Service 1993) and smolt survival studies. Flow needs recommended by DFG are met in many year-types by flows specified in the settlement agreement. However, DFG (1993) stated that, although its flow recommendations were a significant improvement over the recent historical flow releases, they are not the most favorable for salmon spawning, rearing, or emigration, particularly in drier years. The recommended flow pulses in April and May are prescribed to meet these needs in drier years better and to support stream channel and riparian habitat processes.

Existing minimum fishery flows in the lower Stanislaus River are designated in a 1987 study agreement between Reclamation and DFG. This agreement, enacted under a DFG protest of Reclamation's water right applications to divert water from New Melones Dam, specifies interim annual flow allocations for fisheries between 98,300 af and 302,100 af, depending primarily on carryover storage at New Melones and inflow. Instream flow schedules are set annually by DFG in the total annual flow allocation specified in the agreement. In recent years, coordinating fishery and water quality flow releases and releases for water sales and transfers have resulted in additional flow releases that significantly benefit anadromous fish.

DFG (1993) stated that the existing flow requirements are inadequate for fall-run chinook salmon migration, spawning, egg incubation, juvenile rearing, and smolt emigration on the Stanislaus River. Spring flows for smolt emigration are particularly inadequate. There is a positive relationship between spring outflow at Vernalis on the San Joaquin River

and at Ripon on the Stanislaus River to adult escapements into the basin 2½ years later. Results of smolt survival studies completed on the Stanislaus River thus far indicate a positive relationship between smolt survival and spring flow releases. April through May flow events are prescribed for these reasons.

Flow targets recommended by DFG (1993) for the lower Stanislaus River were formulated from results of an instream flow study (U.S. Fish and Wildlife Service 1993) and smolt survival studies. Flows for October through March were determined from results of the instream flow study for salmon spawning, egg incubation, and rearing. Flows during April and May determined from results of the smolt survival studies. The flows are consistent with spring outflow objectives proposed for the basin at Vernalis on the San Joaquin River. Summer flows addressed needs of oversummering yearling salmon and steelhead. Although these flow targets are a significant improvement over the current flow releases, they are not the best possible for salmon spawning, rearing, or emigration, particularly in drier years (California Department of Fish and Game 1993). Again, this is the reason for recommending additional April through May flow pulses.

Flow targets recommended by USFWS (1995) for the Stanislaus River were developed by the San Joaquin Basin Technical Team. Recommended flows were derived from historic flows and results of biological studies. The team believes that implementing the flow schedule, in concert with other recommended actions, would double natural fall-run chinook salmon production in the Stanislaus River.

It is important to note that all of the agreed upon or proposed flows (AFRP, Tuolumne River Settlement Agreement, FERC, VAMP, Davis-Grunsky, and DFG recommended flows) in the Stanislaus, Tuolumne, and Merced rivers were designed to facilitate chinook salmon recovery, and little or no consideration was given to steelhead recovery in the design of these flow strategies. Flow and temperatures requirements of steelhead will need to be evaluated and integrated into the proposed flow regimes.

COARSE SEDIMENT SUPPLY

TARGET 1: Reduce existing levels of erosion and maintain gravel recruitment in tributaries that sustain an adequate level of gravel recruitment, or

restore desirable levels by directly manipulating and augmenting gravel supplies where the natural flow process has been interrupted by dams or other features that retain or remove the gravel supply (◆◆).

PROGRAMMATIC ACTION 1A: Evaluate the feasibility and need for establishing long-term coarse sediment augmentation and fine sediment control programs for streams below major impoundments in the East San Joaquin Ecological Management Zone.

PROGRAMMATIC ACTION 1B: Evaluate spawning gravel quality in areas used by chinook salmon in the Stanislaus River. If indicated, renovate or supplement gravel supplies to enhance substrate quality by importing additional gravel as conditions require.

PROGRAMMATIC ACTION 1C: Evaluate spawning gravel quality in areas used by chinook salmon in the Tuolumne River. If indicated, renovate or supplement gravel supplies to enhance substrate quality.

PROGRAMMATIC ACTION 1D: Evaluate spawning gravel quality in areas used by chinook salmon in the Merced River. If indicated, renovate or supplement gravel supplies to enhance substrate quality.

RATIONALE: Gravel transport is the process whereby flows carry away finer sediments that fill gravel interstices (spaces between cobbles). Gravel cleansing is the process whereby flows transport, grade, and scour gravel. Gravel transport and cleansing, by flushing most fines and moving bedload, are important processes to maintain the amount and distribution of spawning habitat in the Sacramento-San Joaquin River basin. Human activities have greatly reduced or altered these processes. Opportunities to maintain and restore these processes include changing water flow, sediment supplies, and basin geomorphology (earth forming process); removing stressors; or manipulating channel features and stream vegetation directly.

A feasibility study that emphasizes the hydrologic and fluvial geomorphologic aspects of the three watershed need to be conducted early in the program to provide guidance of the development and implementation of potential sediment augmentation programs. This will require the expertise and

knowledge of trained experts. It may be that gravel deposits in streams of the East San Joaquin Basin Ecological Management Zone are essential to maintain spawning and rearing habitats of fall-run chinook salmon, steelhead, and other native fish. Opportunities to maintain and restore gravel recruitment include manipulating natural processes and controlling or managing environmental stressors that adversely affect recruitment.

STREAM MEANDER

TARGET 1: Preserve and expand the stream-meander belts in the Stanislaus, Tuolumne, and Merced Rivers by adding a cumulative total of 1,000 acres of riparian lands in the meander zones (◆◆◆).

PROGRAMMATIC ACTION 1A: Acquire riparian and meander-zone lands by purchasing them directly or acquiring easements from willing sellers, or provide incentives for voluntary efforts to preserve and manage riparian areas on private land.

PROGRAMMATIC ACTION 1B: Build local support for maintaining active meander zones by establishing a mechanism through which property owners would be reimbursed for lands lost to natural meander processes.

PROGRAMMATIC ACTION 1C: Develop a cooperative program to improve opportunities for natural meander by removing riprap and relocating other structures that impair stream meander.

TARGET 2: On the Merced River between the towns of Cressey and Snelling, isolate gravel pits, reconfigure (rearrange) dredge tailings, and restore a more natural channel configuration to 5 to 7 miles of disturbed stream channel. On the Tuolumne River, between river miles (RMs) 25 and 51, isolate 15 to 30 gravel pits, reconfigure dredge tailings, and restore a more natural stream channel to 6 to 9 miles of disturbed stream channel. On the Stanislaus River, restore a more natural stream channel to 2.5 to 5 miles of disturbed stream channel (◆◆◆).

PROGRAMMATIC ACTION 2A: Develop a cooperative program, consistent with flood management, to restore more natural channel configurations to reduce salmonid predator habitat and improve migration corridors.

PROGRAMMATIC ACTION 2B: Work with permitting agencies to appropriately structure future